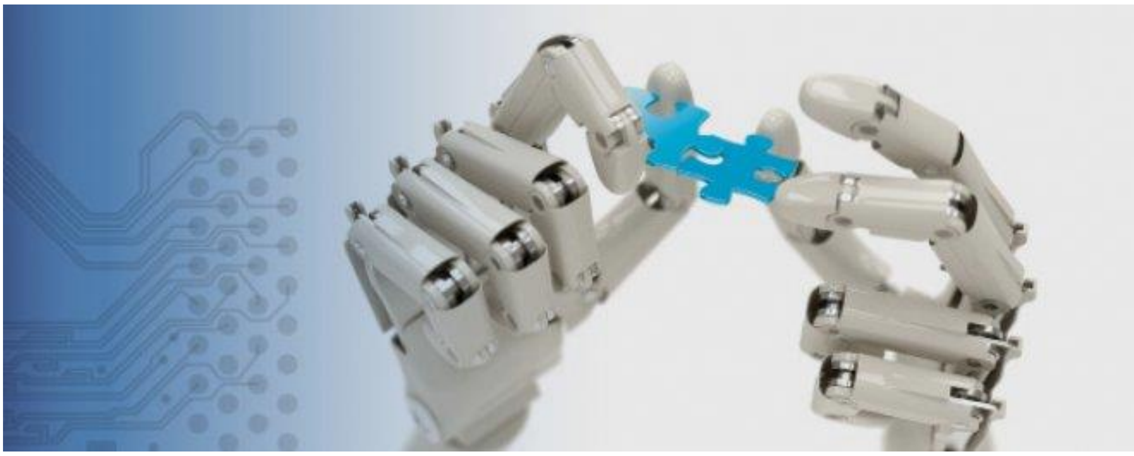
ROBOTICS MASTER

Universitat de Vic



Subject: Perception Systems

Session1: Sensors and Measurements

Exercixse 1.2: Lidar Scanner – Laser hits

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Exercise 1.2.

Go to the link: http://www.hokuyo-aut.jp/02sensor/07scanner/utm_30ln.html , which is a widely used lidar scanner in robotics.

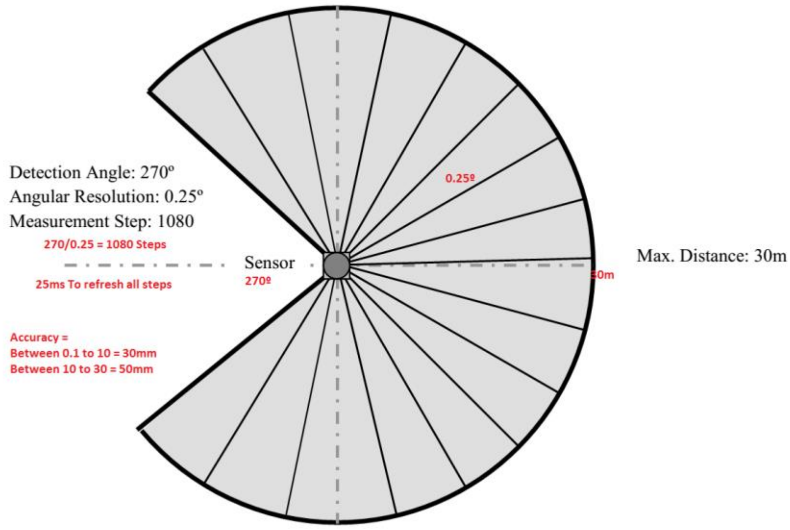
a. Try to understand the specs by drawing them in a XY frame similar to the one of slide 11.
b. which is the scan rate ?
c. How many "laser hits" will get a pedestrian leg situated at 1m? and 3m? and 5m?. Draw a plot distance-hits. (make your own assumption about pedestrian leg size)

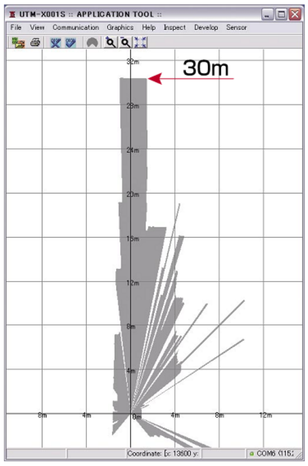
Exercise 1.2.

Go to the link: http://www.hokuyo-aut.jp/02sensor/07scanner/utm_30ln.html, which is a widely used lidar scanner in robotics.

A. Try to understand the specs by drawing them in a XY frame similar to the one of slide 11.

Will be drawn using an image of the datasheet. With this image will be indicated the main technical specifications





B. Which is the scan rate?

Scan Rate is a value not given in the datasheets of this device. The data which can be found in the technical specifications is: "Scan Time = 25ms". Scan time is the time needed to refresh the state of laser hits (1 cycle of scan) of the detection angle (270º). The scan rate can be calculated as follows;

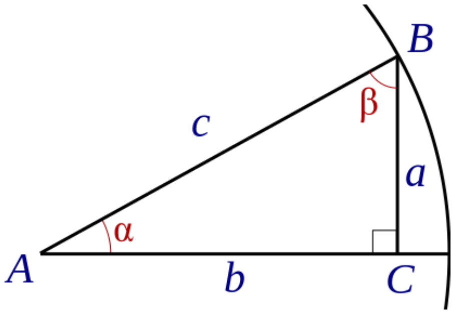
$$f = \frac{1}{T} = \frac{1}{25E-03} = 40Hz$$

C. How many "laser hits" will get a pedestrian leg situated at 1m? and 3m? and 5m?. Draw a plot distance-hits. (make your own assumption about pedestrian leg size)

The following data are assumed and extracted from the datasheet

- Foot with = 20cm (Assumed)
- Detection Range = 0.1 to 30m
- Detection Angle = 270º
- Angular resolution = 0.25º

Considering the resultant shape as a right triangle;



We can apply Pythagoras theorem and a basic formula of trigonometry;

$$c^2 = a^2 + b^2 \rightarrow c = \sqrt{a^2 + b^2}$$

$$\tan \alpha = \frac{a}{b} \rightarrow \alpha = Atan(\frac{a}{b})$$

Applying the tangent trigonometric ratio we can obtain α angle:

1m) $\alpha = Atan\left(\frac{a}{b}\right) = Atan\left(\frac{20}{100}\right) = 11.309º$

3m) $\alpha = Atan\left(\frac{a}{b}\right) = Atan\left(\frac{20}{300}\right) = 3.8141º$

5m) $\alpha = Atan\left(\frac{a}{b}\right) = Atan\left(\frac{20}{500}\right) = 2.2906º$

Once α angle is obtained. Can be known the number of hits received by the pedestrian:

1m) $\frac{11.309}{0.25} = 45.23\ Hits\ received\ at\ 1m\ of\ separation$

3m) $\frac{3.8141}{0.25} = 15.25\ Hits\ received\ at\ 3m\ of\ separation$

5m) $\frac{2.2906}{0.25} = 9.162\ Hits\ received\ at\ 5m\ of\ separation$

To obtain a plot representation of this calculation, will be implemented the tangent trigonometric ratio of α angle;

$$\tan \alpha = \frac{a}{b} \rightarrow \boldsymbol{\alpha = Atan(\frac{a}{b})}$$

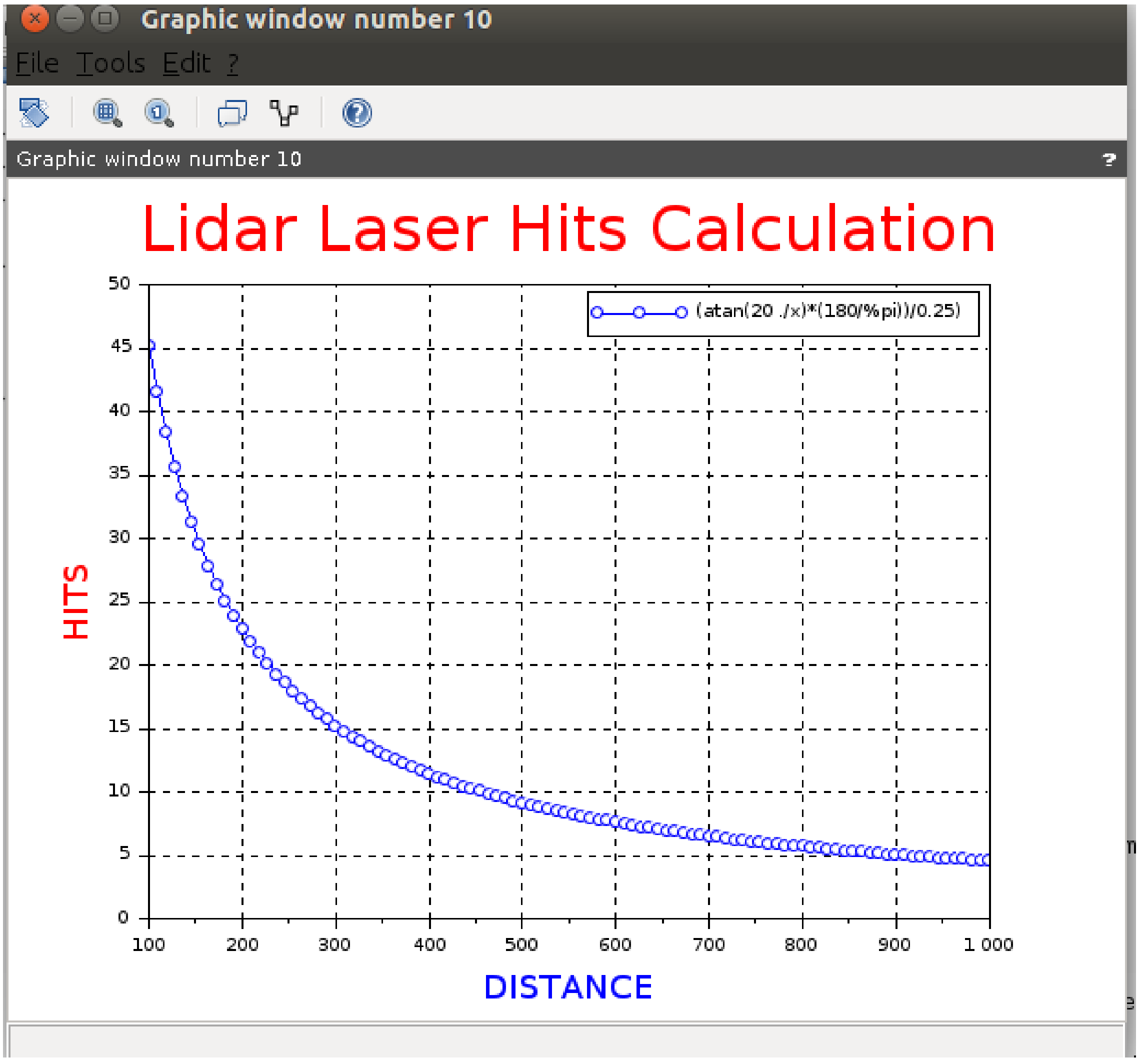
Where;

a → Is a constant in this case (Foot with = 20cm)

b → is a variable value (distance of separation)

Giving different values to “b” this formula can be represented in SciLab

Scilab Plot:



Executed code in Scilab:

```
-->x=linspace(100,1000,100);
-->y=((atan(20 ./x)*(180/%pi))/0.25);
-->scf(10);
-->clf(10);
-->plot (x,y,'o-b')
-->ylabel("HITS","fontsize",4,"color","red")
-->xlabel("DISTANCE","fontsize",4,"color","blue")
-->title("Lidar Laser Hits Calculation","color","Red","fontsize",6);
-->set(gca(),"grid",[1 1]);
-->legend("(atan(20 ./x)*(180/%pi))/0.25)");
```